

# NASA TECH BRIEF



NASA Tech Briefs are issued to summarize specific innovations derived from the U.S. space program, to encourage their commercial application. Copies are available to the public at 15 cents each from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

## Computer Program Resolves Radiative, Conductive, and Convective Heat Transfer Problems for Variety of Geometries

A computer program has been developed that computes temperature distribution as a function of time in a given body which has been subdivided into a network of nodes. The nodes may be numbered arbitrarily but the program is presently limited to 100 nodes.

Methods of heat transfer between nodes may be either conduction, convection, or radiation, and provision for fluid nodes is included. Thermal properties and boundary conditions may vary with time. Thermal resistances and capacitances may be computed by program from nodal geometry.

The program solves the problem by generating a system of first order differential equations and obtaining an incremental solution by using a method of backward finite differences.

Before it is possible to prepare input data for this program, it is necessary to subdivide the body under consideration into a reasonable number of subelements called nodes. The nodes must be either of two shapes, namely a rectangular parallelepiped or prism. These two shapes are defined as follows.

**Rectangular Parallelepiped:** a solid whose surface is made up of three pairs of parallel faces, each of which is either a rectangle or a square.

**Prism:** a solid whose surface is made up of three pairs of opposite sides, one pair of which is parallel (but not necessarily identical) rectangles, whose edges are parallel in pairs. An additional assumption is that

a line connecting the centroids of the two parallel rectangles is normal to both. Thus the other four sides are right trapezoids, each being congruent to the one directly across from itself.

Node numbers are positive integers less than 100, may be assigned arbitrarily, and need not be consecutive. Each face of a node must touch only one other node face, and their respective surfaces must coincide exactly. Thus each node may connect with no more than 6 other nodes; in fact 6 and only 6 connections for each node are assumed. In the event that some of the connections are not used, dummy connections must be provided to bring the number to 6.

### Notes:

1. The program has been developed for the IBM 7094 and the programming language is Fortran IV.
2. Inquiries concerning this program may be directed to:

COSMIC  
Computer Center  
University of Georgia  
Athens, Georgia 30601  
Reference: B67-10329

### Patent status:

No patent action is contemplated by NASA.

Source: A. L. McGarrity and R. Elkin  
of Marshall Space Flight Center  
(MFS-1910)

Category 06